

Notice of Allowability

Application No.

10/719,134

Examiner

Steven Bos

Applicant(s)

WURM ET AL.

Art Unit

1793

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the amendment and remarks filed.
2. ☒ The allowed claim(s) is/are 1-5,8-13.
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
 5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material

5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413),
Paper No./Mail Date _____
7. ☐ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____

Steven Bos
Primary Examiner
Art Unit: 1793

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claim 1 (Previously Presented): A process for the manufacture of a LiMPO_4 powder, comprising the steps of:

providing an equimolar aqueous solution of Li^{1+} , M^{n+} , and PO_4^{3-} prepared by dissolving components which are susceptible to coexist as solutes in an aqueous system and which, upon heating at a temperature below 500°C , decompose to form a pure homogeneous Li and M phosphate precursor;

evaporating water from the solution, thereby producing a solid mixture;

decomposing the solid mixture at a temperature below 500°C to form a pure homogeneous Li and M phosphate precursor; and

annealing the precursor at a temperature of less than 800°C in an inert or reducing atmosphere, thereby forming a LiMPO_4 powder of olivine structure;

wherein M^{n+} is one or more of Fe^{2+} , Fe^{3+} , Co^{2+} , Ni^{2+} , and Mn^{2+} , and M is $\text{Fe}_x\text{Co}_y\text{Ni}_z\text{Mn}_w$, with $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$, $0 \leq w \leq 1$, and $x + y + z + w = 1$.

Claim 2 (Original): The process according to claim 1, wherein in the step of annealing the precursor, the annealing temperature is less than 600°C .

Claim 3 (Previously Presented): A process for the manufacture of a LiFePO_4 powder, comprising the steps of:

providing an equimolar aqueous solution of Li^{1+} , Fe^{3+} , and PO_4^{3-} prepared by dissolving components which are susceptible to coexist as solutes in an aqueous system and which, upon heating at a temperature below 500°C , decompose to form a pure homogeneous Li and Fe phosphate precursor;

evaporating water from the solution, thereby producing a solid mixture;

decomposing the solid mixture at a temperature below 500°C to form a pure homogeneous Li and Fe phosphate precursor; and

annealing the precursor at a temperature of less than 800°C in a reducing atmosphere, thereby forming a LiFePO_4 powder of olivine structure.

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Claim 4 (Original): The process according to claim 3, wherein in the step of annealing the precursor, the annealing temperature is less than 600° C.

Claim 5 (Previously Presented): The process according to claim 3, wherein the Fe³⁺ bearing component is iron nitrate.

Claims 6 - 7 (Cancelled)

Claim 8 (Previously Presented): A powder for use in lithium insertion electrodes prepared by a process comprising the steps of:

providing an equimolar aqueous solution of Li¹⁺, Mⁿ⁺, and PO₄³⁻ prepared by dissolving components which are susceptible to coexist as solutes in an aqueous system and which, upon heating at a temperature below 500° C, decompose to form a pure homogeneous Li and M phosphate precursor;

evaporating water from the solution, thereby producing a solid mixture;

decomposing the solid mixture at a temperature below 500° C to form a pure homogeneous Li and M phosphate precursor; and

annealing the precursor at a temperature of less than 600° C in an inert or reducing atmosphere, thereby forming a LiMPO₄ powder of olivine structure and having an average particle size of less than 1 μm;

wherein Mⁿ⁺ is one or more of Fe²⁺, Fe³⁺, Co²⁺, Ni²⁺, and Mn²⁺, and M is Fe_xCo_yNi_zMn_w, with 0 ≤ x ≤ 1, 0 ≤ y ≤ 1, 0 ≤ z ≤ 1, 0 ≤ w ≤ 1, and x + y + z + w = 1.

Claim 9 (Original): The powder according to claim 8, wherein Mⁿ⁺ is Fe³⁺, M is Fe and the annealing occurs in a reducing atmosphere.

Claim 10 (Previously Presented): A battery comprising a lithium insertion electrode including a powder prepared by a process comprising the steps of:

providing an equimolar aqueous solution of Li¹⁺, Mⁿ⁺ and PO₄³⁻ prepared by dissolving components which are susceptible to coexist as solutes in an aqueous system and which, upon heating at a temperature below 500° C, decompose to form a pure homogeneous Li and M phosphate precursor;

evaporating water from the solution, thereby producing a solid mixture;
decomposing the solid mixture at a temperature below 500° C to form a pure homogeneous Li and M phosphate precursor; and
annealing the precursor at a temperature of less than 600° C in an inert or reducing atmosphere, thereby forming a LiMPO₄ powder of olivine structure and having an average particle size of less than 1 μm;
wherein Mⁿ⁺ is one or more of Fe²⁺, Fe³⁺, Co²⁺, Ni²⁺, and Mn²⁺, and M is Fe_xCo_yNi_zMn_w, with $0 \leq x \leq 1$, $0 \leq y \leq 1$, $0 \leq z \leq 1$, $0 \leq w \leq 1$, and $x + y + z + w = 1$.

Claim 11 (Previously Presented): The battery according to claim 10, wherein $x + z + w > 0$.

Claim 12 (Original): The battery according to claim 11, wherein M is Fe, the powder having a reversible electrode capacity of at least 65% of a theoretical capacity when used as an active component in a cathode that is cycled between 2.70 and 4.15 V vs. Li⁺/Li at a discharge rate of C/5 at 25° C.

Claim 13 (Original): The battery according to claim 10, wherein Mⁿ⁺ is Fe³⁺, M is Fe, and the annealing occurs in a reducing atmosphere.

Claims 14-17 (Cancelled)